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Making the Invisible Visible: Exploring and Addressing Water Pollution

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Edith Widder All krill are bioluminescent. They produce light from light organs on their bellies that they use to camouflage their silhouettes so they can't be detected by upward-looking predators hunting for silhouettes against the downwelling sunlight. [Go to related article »](#)

Overview | What is bioluminescence, and what function does it play in living organisms? How have researchers harnessed bioluminescence in studies of toxicity and pollution? In this lesson, students explore deep-sea bioluminescence, learn how scientists use this property to identify contaminants in water and participate in a forum on water pollution.

Science

Teaching ideas based on New York Times content.

- [See all in Science »](#)
- [See all lesson plans »](#)

Materials | Student journals, computers with Internet access, projector.

Warm-Up | Have students spend a few minutes responding to the following questions in their journals:

Have you heard of bioluminescence? If so, what is it? If not, what do you think it might be?

What organisms do you know or believe have this property?

What functions do you think bioluminescence has?

What are three questions you have about the property of bioluminescence?

Invite students to share their thoughts, then show the video "[Edith Widder's New Crusade.](#)"

Ask: Were you surprised to learn about how widespread bioluminescence is in the ocean?

What are some of the ways in which marine animals use this property? How does Dr.

Widder propose using it to tackle the challenge of ocean pollution?

To reinforce some of the ideas presented in the video, you might look together at the images and captions in The Times's slide show "[Natural Light.](#)"

Explain that they will now read an article that goes into greater depth about how Dr. Widder studies bioluminescence in marine organisms and her plans for using it to better inform policy makers regarding water pollution.

Related | In the article "[Illuminating the Perils of Pollution, Nature's Way,](#)" Erik Olsen reports on deep-sea biologist Edith Widder's latest venture to track aquatic pollution:

Over a career spanning almost 30 years, Dr. Widder has made hundreds of dives

in deep-sea submersibles to study the remarkable number and diversity of animals that make light. This ability, called bioluminescence, is strikingly common, shared by as many as 90 percent of the creatures in the open ocean.

“Animals use light to help them survive, to help them find food, to attract mates and to defend against predators,” she said. For example, in the ocean — “where there are no trees or bushes to hide behind” — a bioluminescent creature can use light to attract larger predators to its own enemies.

Now, Dr. Widder has found a way to put bioluminescence to work to fight pollution in the Indian River Lagoon, a 156-mile estuary that scientists say is one of Florida’s most precious and threatened ecosystems.

Read the entire article with your class, using the questions below.

Questions | For discussion and reading comprehension:

- What is bioluminescence? How do animals use this property?
- What are sediments?
- How does Dr. Widder use bioluminescence to detect the presence of toxins in sediment samples she collects?
- Why does she say sediments are a better indicator of pollution levels than water samples?
- What is the Eye-In-The-Sea? How is this device able to document deep-sea creatures that have long eluded scientists in research submarines?

Activity | Remind students that in the video they watched, Dr. Widder says, “If you want to help a dolphin, clean up its water.” Explain that in keeping with her suggestion, they will participate in a forum on water pollution.

Begin by having the class, as a class or in small groups, brainstorm a list of questions they might ask about water pollution, like, “What are some of the most common [sources of pollution](#) in ocean ecosystems?” or “What are some sources of water pollution in our [community](#)?” Jot ideas on the board.

After a few minutes of brainstorming, divide the class into four groups (and subdivide further as necessary depending on class size). Assign each group one of the topics identified below to research in preparation for a forum on water pollution. To help students get started, give each group the following guiding questions to direct their research. Groups also should be sure to address any related questions that came up during the class brainstorm.

Group 1: Types and Sources of Water Pollution

RELATED RESOURCES From The Learning Network

- [6 Qs About the News: Fighting Pollution With the Language of Light](#)
- [The Drill on the Spill: Learning About the Gulf Oil Leak in the Lab](#)
- [Floating Flotsam: Studying the Pacific Garbage Patch](#)

From NYTimes.com

- [Times Topics: Water Pollution](#)
- [Series: Toxic Waters](#)
- [Op-Ed: Keep the Clean Water Act Strong](#)

Around the Web

- [YouTube: Glowing Life in an Underwater World](#)
- [NOAA Ocean Service Education: Pollution](#)
- [Nova: Glowing in the Dark](#)

Topics to consider include some or all of the following:

- [Sewage outflows](#).
- Hydraulic fracturing, or “fracking,” which the Environmental Protection Agency [recently implicated in tainting groundwater supplies](#).
- Shipping and other industries contributing to [marine pollution](#).
- [Phosphorus and plastics pollution in the oceans](#), which the United Nations recently identified as emerging global issues.
- [Point source](#) and [nonpoint source](#) pollution.
- Major water pollution events like the [Gulf oil spill](#).

Group 2: Emerging Technologies to Identify Sources of Water Pollution

Students in this group should explain and describe emerging technologies like these:

- Use of [living organisms](#) to detect pollution, starting with Dr. Widder’s work to “[make the invisible visible](#)” as well as the steps in the FAST test she developed, and interpret the data the test provides.
- Other applications of bioluminescent bacteria in systems like [wastewater treatment](#).
- Testing [microbial genetics](#).
- Using organisms like [tadpoles to detect pollution](#).

Group 3: Policies and Water Regulation

Students in this group should focus on government policy and regulation, especially the work of the [Environmental Protection Agency](#) with respect to water. They should also:

- Describe the [Clean Water Act](#) and identify recent [recommendations](#) for changes to the act.
- Explore some of the provisions of the Act that establish various water pollution control measures, like the [National Pollutant Discharge Elimination System](#), which regulates companies, municipal facilities and other point sources of pollution, and the requirement that states adopt water quality standards that set guidelines for the [maximum amounts](#) of various pollutants that can enter a body of water.
- Consider how the Act covers